Project B-209

# SYNTHETIC RUBBER

## A Manufacturing Opportunity in Georgia

Prepared for
The Georgia Department of Commerce
Jack Minter, Director
100 State Capitol
Atlanta, Georgia

By

Wade McKoy

Industrial Development Division
Engineering Experiment Station
GEORGIA INSTITUTE OF TECHNOLOGY
December 1962

TABLE OF CONTENTS



Tables

Page

Maps



Appendices 20

# Foreword

This is the first in a new series of product-industry studies being carried out for the Georgia Department of Commerce. Others in process include pharmaceuticals, toiletries, industrial and farm pumps, flat glass, industrial rubber products, and the updating of the electronics study originally prepared in 1959.

Inquiries from individual companies interested in specifics relating to their particular needs and location requirements are invited and will be treated with complete confidence.

Requests for additional studies or indications of interest in particular fields are also invited as an aid to the programming of future studies. The establishment of priorities on analyses planned in the months ahead can, where appropriate, be changed to meet the time pressures of interested manufacturers.

Kenneth C. Wagner, Chief
Industrial Development Division
GEORGIA INSTITUTE OF TECHNOLOGY

## Summary

Georgia is the center of the second largest synthetic rubber consuming area in the United States. A synthetic rubber plant in Georgia could supply this market at a smaller delivered cost than a Gulf Coast plant.

In the six-state area of Alabama, Tennessee, Georgia, North Carolina, Florida and South Carolina, 160 establishments manufacture rubber goods. In 1958 the area consumed more than 146,000 long tons of rubber and 13% of the synthetic rubber used in the United States.[1/]

Georgia would provide an excellent location for synthetic rubber plants for the following reasons:

1. The cost of producing synthetic rubber in Georgia has been compared with the cost of producing it in Texas and found to be approximately the same.

2. The cost of shipping the raw material in is less than that of shipping the crude synthetic rubber in. The major raw material can be shipped in as a liquid, whether it is butadiene, styrene, isoprene or propylene. Ship and barge transportation is available from the Gulf into Georgia. Using 30,000 gallon tank cars, rail rates will be as low as barge rates.

3. Freight costs on the finished product to almost the entire market east of the Mississippi River will be lower from Georgia than from Texas and will be much less to the large southeastern market.

Georgia's superiority as a location is supported by the following five points:

1. It has a large rubber market which has been growing at five times the U. S. average. It is closer to the East North Central states, such as Ohio, than the plants in Texas and Louisiana. The amount of profit over a Texas plant will increase proportionately to the amount of product shipped east and north of the Georgia plant.

2. It is convenient to the raw materials with low cost transportation by barge, rail and pipe line from the Gulf Coast.

3. Natural gas rates are lower than in the surrounding states.[2/]

---

1/ U. S. Census of Manufactures: 1958, Bureau of the Census, U. S. Department of Commerce.

2/ Alabama, East Tennessee, Florida, North Carolina, South Carolina, Kentucky, and Virginia.

4. Process and cooling water is plentiful.

5. New developments are increasing the feasibility of a regional chemical complex in Georgia. One of these is the Dixie LPG line across the middle of the state that began operation early in 1962. Compatible plants in the same area could use by-products from and provide raw materials to the synthetic rubber plant.

# INTRODUCTION

This report is the result of an investigation to determine the opportunities in Georgia for the location of a synthetic rubber plant.

The synthetic rubber industry is undergoing a period of rapid change. Clayton F. Reubensaal, Director of Commercial Planning, Texas-U. S. Chemical Company, has said: "The next five years should be a period of dynamic change...in which rubber will once again be looked on...as having all the challenges and glamor of the best of the growth industries."

The beginning of this change is the commercial production of the new stero synthetic rubbers: Cis-polyisoprene and Cis-polybutadiene. This is being followed by ethylene-propylene rubber which recently became available. Announcements have been made of developments in urethane rubbers and of sulfur-curable ethylene-propylene terpolymers.

The major use of the new stereo synthetic rubbers will be to replace natural rubber in items where previous synthetics have not had the necessary properties. At present, natural rubber consumption in the United States is 425,000 long tons per year or 28% of the total new rubber consumption.

A trend toward the use of Cis-polybutadiene as a replacement for styrene butadiene rubber (SBR) has been noticed. The United States consumption of SBR was 888,000 long tons in 1961.

The capacity for stereo synthetic rubbers by the end of 1962 will be 250,000 long tons. The 1967 capacity is estimated at 350,000 long tons by technical reporters. This is a predicted 40% increase that will be planned and built in the next five years. Three to five new plants will be needed. This report considers the feasibility of establishing one or more of these plants in Georgia.

## PLANT LOCATION FACTORS

### Market

The six-state area of Alabama, Tennessee, Georgia, North Carolina, South Carolina and Florida -- referred to as the study area in this report -- forms the second largest synthetic rubber consuming area in the United States. The area consumption of synthetic and natural rubber was 146,347 long tons in 1958, with synthetic accounting for 101,672 long tons. This represents 13% of the U. S. synthetic consumption. (See Map 1.) In Table 1, the regional consumption of rubber is listed in long tons and as a percent of United States consumption.

---

Table 1

TOTAL AND REGIONAL CONSUMPTION OF RUBBER IN THE UNITED STATES
(1958)

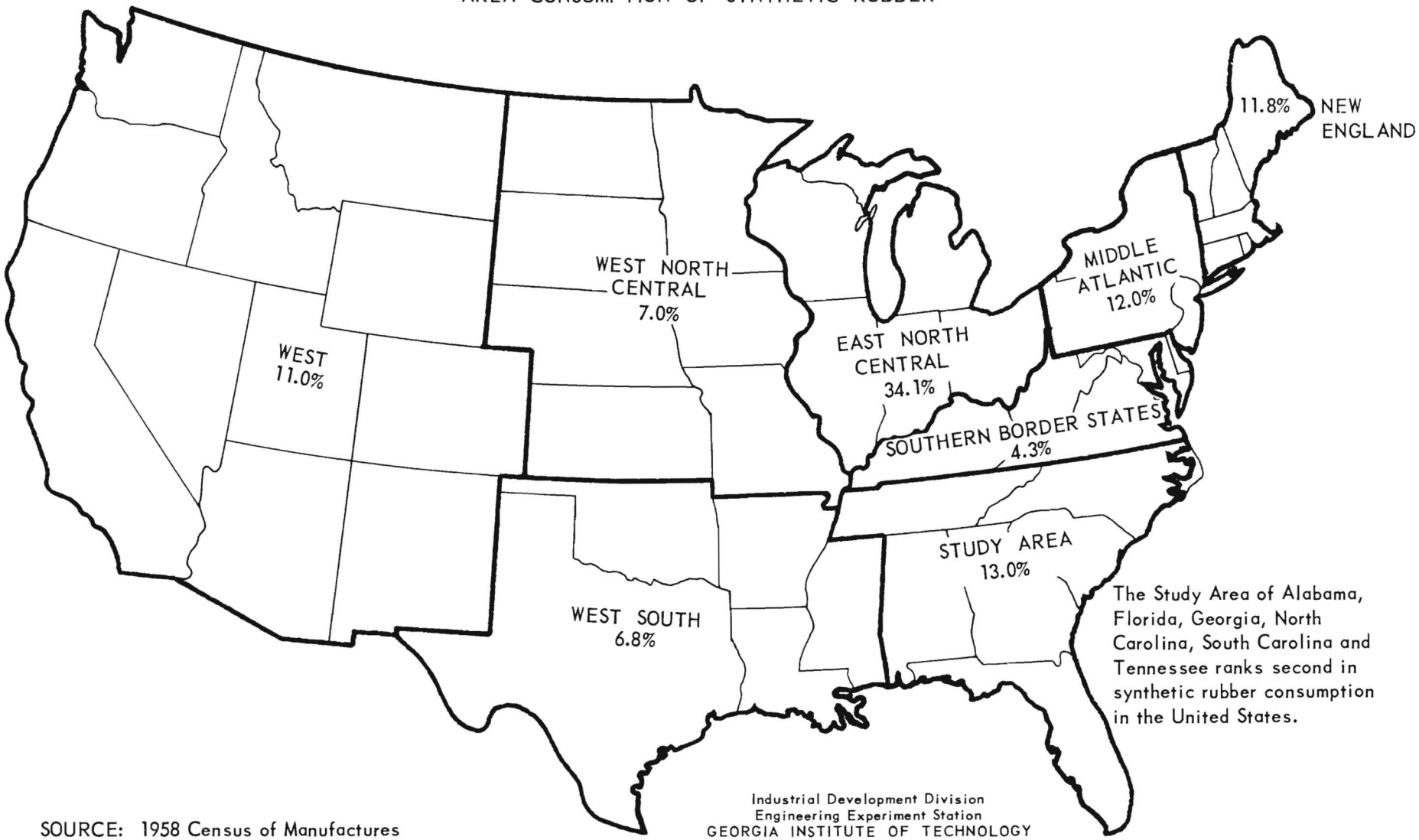
| Region | Natural Rubber | | Synthetic Rubber | | Total of Natural and Synthetic | |
|---|---|---|---|---|---|---|
| | Quantity (Long Tons) | % of U.S. | Quantity (Long Tons) | % of U.S. | Quantity (Long Tons) | % of U.S. |
| Total U. S. | 464,115 | | 781,028 | | 1,245,143 | |
| Study Area | 44,675 | 9.6 | 101,672 | 13 | 146,347 | 11.8 |
| Alabama | 20,362 | | 57,345 | | 77,707 | |
| Tennessee | 16,007 | | 25,172 | | 41,179 | |
| Georgia | 5,220 | | 10,417 | | 15,637 | |
| North Carolina | 2,922 | | 7,318 | | 10,240 | |
| South Carolina and Florida | 164 | | 1,420 | | 1,584 | |
| New England | 64,872 | 14.0 | 92,359 | 11.8 | 157,231 | 12.6 |
| Middle Atlantic | 52,441 | 11.3 | 93,998 | 12.0 | 146,439 | 11.8 |
| E. North Central | 186,630 | 40.2 | 266,169 | 34.1 | 452,799 | 36.4 |
| W. North Central | 29,678 | 6.4 | 54,563 | 7.0 | 84,241 | 6.8 |
| Southern Border States | 17,645 | 3.8 | 33,490 | 4.3 | 51,137 | 4.1 |
| West South | 24,092 | 5.2 | 52,890 | 6.8 | 76,982 | 6.2 |
| West | 44,070 | 9.5 | 85,887 | 11.0 | 129,957 | 10.4 |

---

Source: U. S. Census of Manufactures: 1958, Bureau of the Census, U. S. Department of Commerce. Rubber and Miscellaneous Plastics Products, Industry Report MC58(2)-30A, Table 7B.

MAP 1

AREA CONSUMPTION OF SYNTHETIC RUBBER




The Study Area of Alabama, Florida, Georgia, North Carolina, South Carolina and Tennessee ranks second in synthetic rubber consumption in the United States.

SOURCE: 1958 Census of Manufactures

Industrial Development Division
Engineering Experiment Station
GEORGIA INSTITUTE OF TECHNOLOGY

The rubber industry in the study area has 160 plants which are distributed as indicated in Table 2. Map 2 shows the location of the plants, and the towns, companies and products are identified in Appendix 1.

Table 2

DISTRIBUTION OF RUBBER GOODS PLANTS,
BY STATES, IN THE STUDY AREA

| State | Plants |
|---|---|
| Alabama | 22 |
| Florida | 19 |
| Georgia | 45 |
| North Carolina | 29 |
| South Carolina | 11 |
| Tennessee | 34 |
| Total | 160 |

The potential for increased consumption of rubber in the study area is influenced by the following factors:

1. The South is increasing its percentage of the national rubber goods manufacture.[1/] A comparison of the information available in the 1954 and 1958 Census of Manufactures shows that while the U. S. consumption of synthetic and natural rubber increased 6%, the study area's consumption increased 30%.

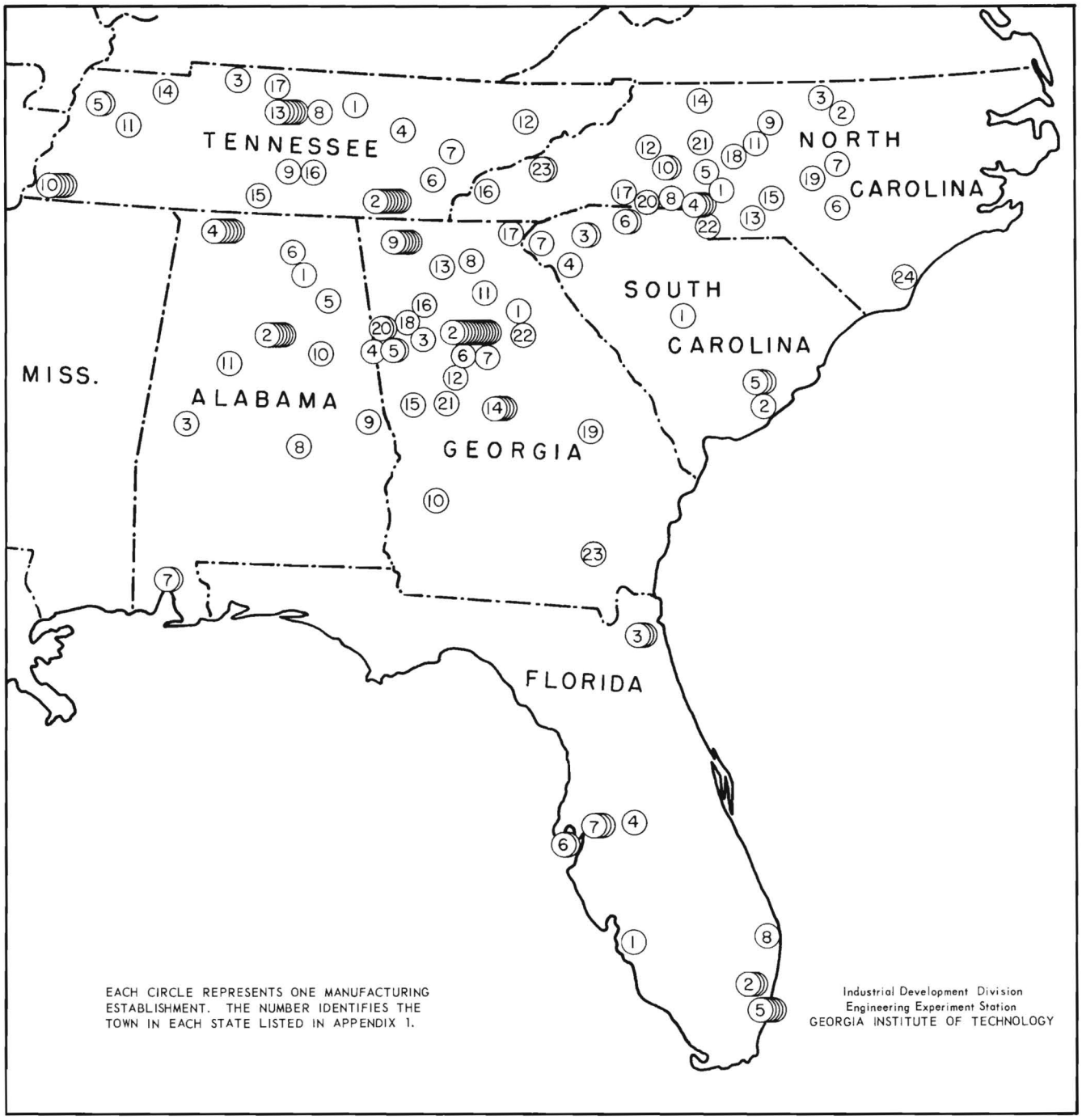
2. Plants consuming rubber products are increasing in the study area. Automobile assembly plants, container plants and footwear manufacturers are examples.

3. Increased national consumption of rubber is predicted. More tires, which consume 63% of the total rubber output, will be produced. George R. Vila, President of the United States Rubber Company, predicts that by 1965 there will be a demand for 135 million passenger car and truck tires -- 14.7% or 17 million more tires than were produced in 1961. By 1970, a total of approximately 155 million tires will be needed to meet the national demand -- an increase of more than 31% or 37 million new tires.

1/ "South is Big Rubber Market," Chemical & Engineering News, September 11, 1961, p. 44.

MAP 2

LOCATION OF RUBBER GOODS PLANTS IN THE STUDY AREA



4. The costs of manufacture of rubber products are lower in the study area than they are in the traditional rubber manufacturing areas. This includes major cost items such as raw materials, utilities and labor.[1/]

Raw Materials

The major raw materials for making synthetic rubber are butadiene and styrene. Another raw material is isoprene, which can be made from propylene. The weight in pounds per gallon and the shipping pressure in pounds per square inch gauge (psig) at 90° F. are shown in Table 3.

Table 3

CHARACTERISTICS OF SYNTHETIC RUBBER RAW MATERIALS

| Material | Weight (#/gal.) | Pressure (psig) |
|---|---|---|
| Butadiene | 5.1 | 38 |
| Styrene | 7.5 | zero |
| Isoprene | 5.6 | zero |
| Propylene | 4.2 | 193 |

The availability in Georgia of petrochemical raw materials is directly related to the feasibility of shipping in these materials. Raw material shipping costs are an important factor for a plant located in Georgia. The materials listed in Table 3 can be shipped as a liquid. Several different methods of shipment are available.

Shipment by Water. Raw materials can be shipped by barge from sources either on the Gulf Coast or the inland waterway to a plant located on Georgia's Chattahoochee River or Flint River. Also possible is shipment of raw materials from sources along the Atlantic Coast, such as the Delaware Valley refineries, to Georgia's Atlantic ports or up the Savannah River to Augusta. A 600-horsepower tug and a 430,000-gallon barge can deliver isoprene to Columbus, Georgia, from Beaumont, Texas, for 1.3 cents a gallon. The shipment of butadiene or propylene would cost up to 1.7 cents a gallon since high pressure barges would be required. A round-trip would require about 15

1/ "South is Big Rubber Market," Chemical & Engineering News, September 11, 1961, p. 44.

days, allowing 12 hours for each loading and unloading, according to an estimate made by officials of a barge line now operating from the Texas Gulf Coast to the Georgia rivers. The line has pressure barges in service that are suitable for propylene shipments.

The mileage between points along the inland waterways is shown on Map 3. The nine-foot channel to Columbus, Georgia, will be available in the spring of 1963. In January, 1963, the state docks and transit shed will be completed in Columbus. Bainbridge has had these facilities since 1957 and receives a variety of commodities by barge. Augusta's new state docks are now in operation. Work just completed on the Savannah River by the Corps of Engineers provides a nine-foot channel to Augusta all year. Savannah and Brunswick have established deep water facilities.

Shipment by Rail. Lower rail rates exist in areas where shipment by water is possible. The big tank cars, such as the new 30,000 gallon tank car, will handle pressure shipments including propylene. With this type of equipment, rail rates could be as low as barge rates. The routings from several points in Texas and Louisiana to points in Georgia have been checked and are adequate for handling this big car. Another advantage of the tank car over the barge is that the plant would need less storage capacity. Using the larger tank car size would also mean fewer tank cars for the plant to handle. For example, in the cost estimate for the isoprene plant (Table 5), an average of 1.6 cars per day would be needed when using the 30,000 gallon size. As a comparison, a 10,000 gallon car would average five cars per day.

Pipe Lines. Fuel and possibly raw material can be transported in pipe lines. Three different types of pipe lines run through the state: natural gas, LPG, and refined products. The natural gas pipe lines are shown on Map 4, and the LPG and refined products pipe lines are shown on Map 5.

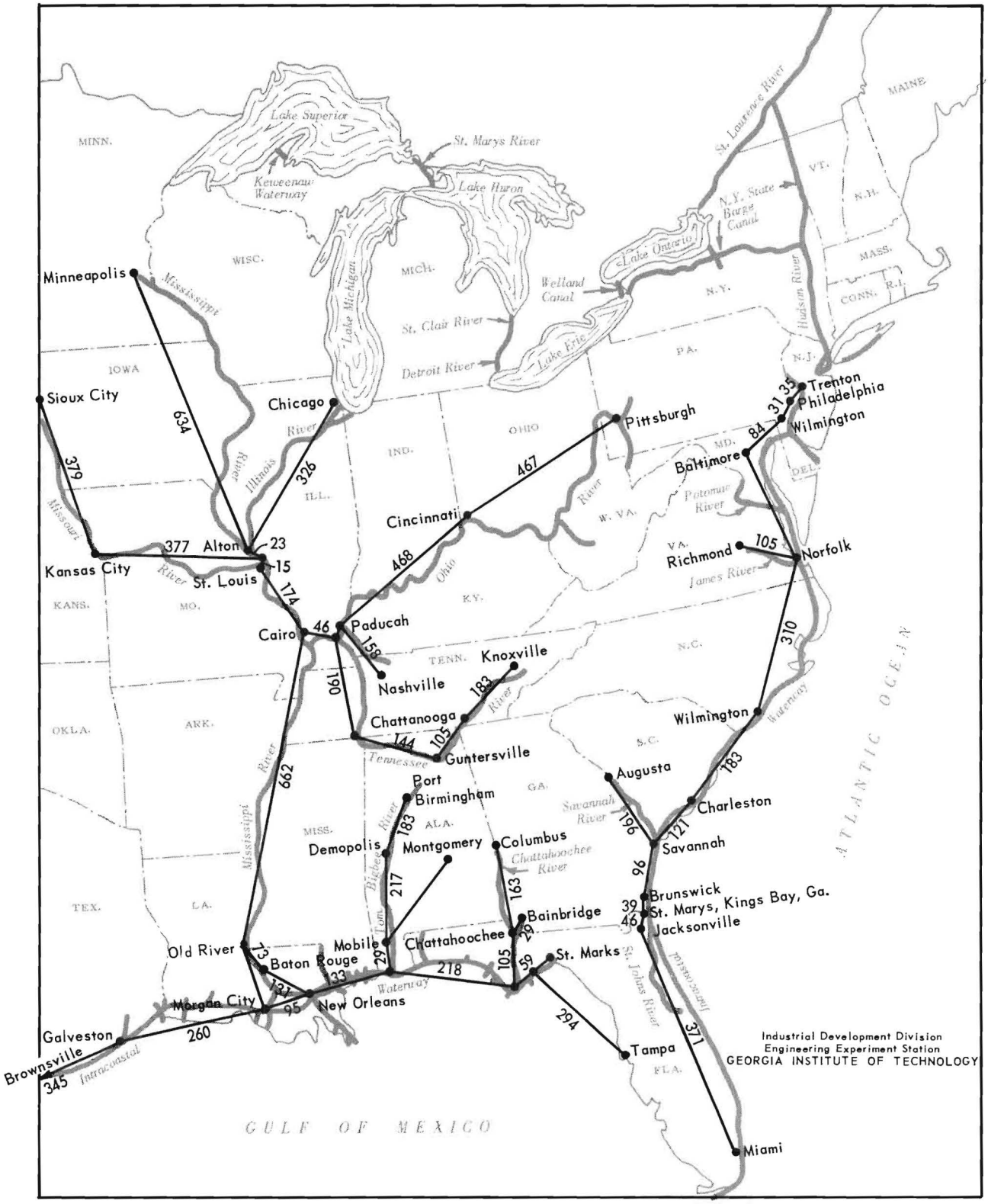
Natural gas pipe lines of several companies run through Georgia. Southern Natural Gas Company has two main lines. They provide the lowest cost gas in Georgia and the surrounding states.[1/] Two gas companies that purchase their gas from Southern Natural Gas Company offer the following rates

---

1/ Alabama, East Tennessee, Florida, North Carolina, South Carolina, Virginia and Kentucky.

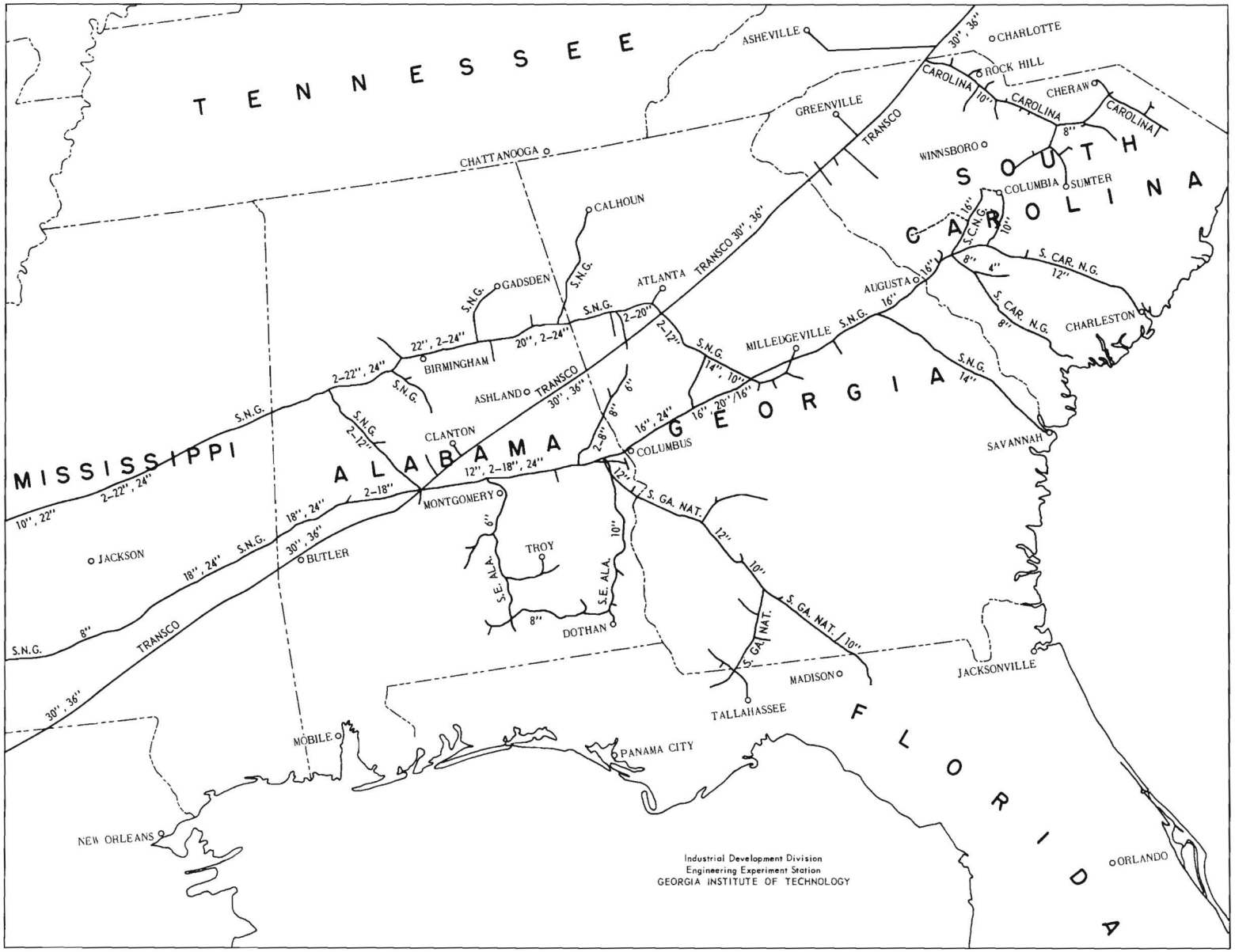
MAP 3

MILEAGE CHART OF NAVIGABLE WATERWAYS



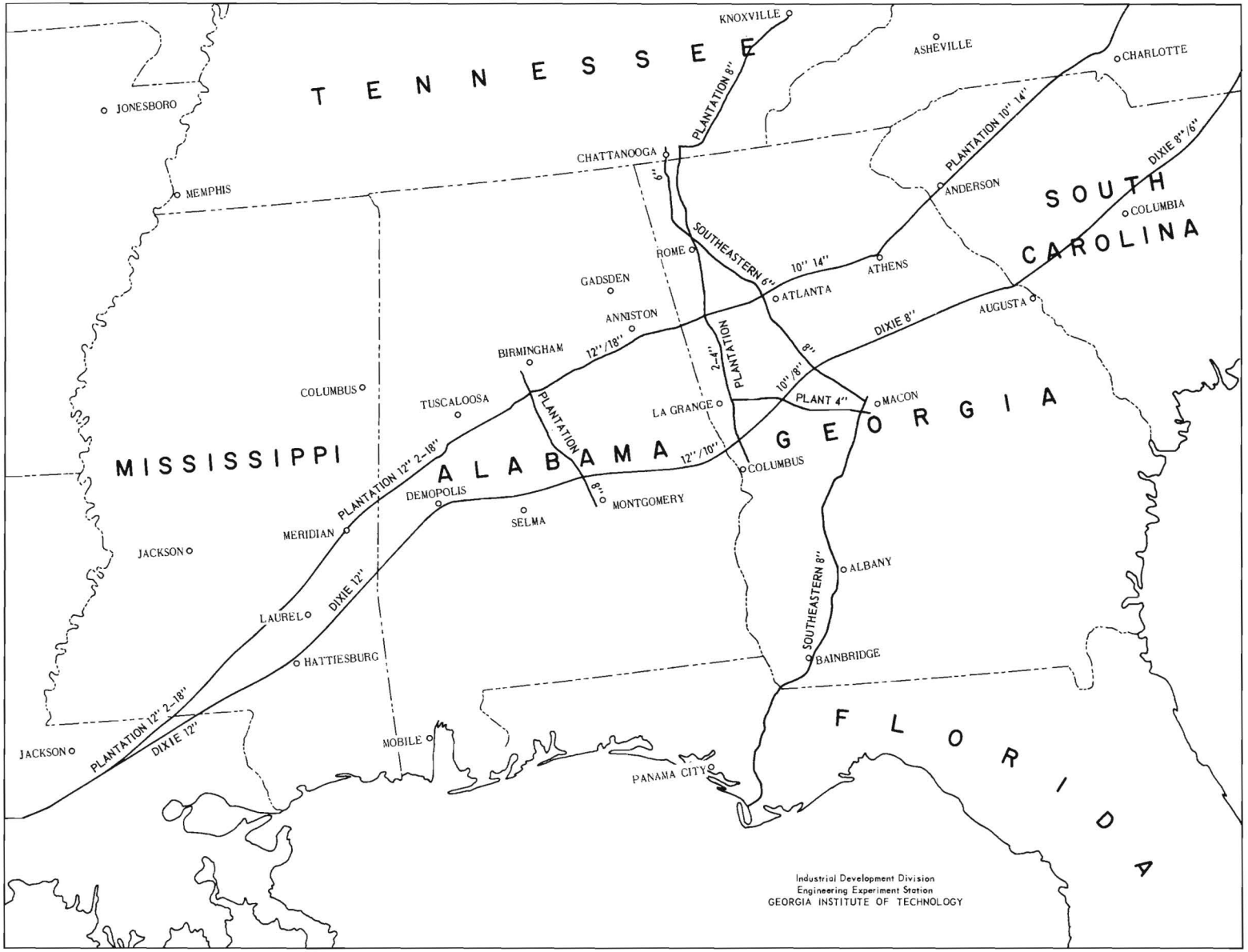
MAP 4

NATURAL GAS PIPE LINES



MAP 5

LIQUID PETROLEUM GAS AND REFINED PRODUCTS
PIPE LINES



for interruptible service:

Columbus Gas Light Company - - - 2.728 cents per therm
Atlanta Gas Light Company - - - - 2.76 cents per therm

The Transcontinental Gas Pipe Line Corporation's lines that pass through the state have a capacity of two billion cubic feet per day. Most of this is marketed in Pennsylvania, New York and New Jersey. South Georgia Natural Gas Company serves the southwest section of the state.

The Dixie Pipe Line Company's LPG pipe line began operation in January, 1962. Present terminals serving Georgia are located at Griffin, Georgia, Opelika, Alabama, and Columbia, South Carolina. The capacity of this line is approximately 50,000 barrels per day, but only 60% utilization is expected for the next few years. Propane is the only shipment now planned. However, Dixie is a common carrier and will consider liquid shipments other than propane. The pipe line company will issue a tariff for acceptable materials. The following are rates in cents per gallon from the tariff schedule effective December 15, 1961:

| From | To Opelika, Alabama | To Griffin, Georgia |
|---|---|---|
| Mont Belview, Texas | 1.76 | 1.975 |
| North Baton Rouge, Louisiana | 1.145 | 1.355 |

The refined products pipe lines of Plantation Pipe Line Company run through Georgia from Baton Rouge, Louisiana. In 1961 these lines averaged 329,000 barrels per day -- 70% gasolines, with the remainder being diesel fuels, jet fuels, kerosene and fuel oils. The minimum tender is 25,000 barrels. The rate from Baton Rouge, Louisiana, to Columbus, Georgia, is 27.3 cents a barrel (0.65 cents per gallon). The other terminals in Georgia have proportionate rates.

Southeastern Pipe Line Company originates at Port St. Joe, Florida, and runs northward through the state with terminals at Bainbridge, Albany, Americus, Macon, Griffin and Atlanta.

Colonial Pipe Line Company was formed recently and proposes to build a refined products pipe line that will run through Georgia. The plans call for

a 36-inch line with a 600,000 barrel per day initial throughput. It proposes to originate in the Houston, Texas, area and go to New York, N. Y. When this new pipe line is built there will be an excess of capacity which could bring about changes in the practices of the refined products pipe line companies, such as considering smaller minimum tenders. The problems of using the refined products pipe lines for transportation of different kinds of raw materials are the large volume required for a minimum tender, contamination from co-mingling, and water pickup.

Site Requirements

The site requirements that are considered important for a synthetic rubber plant are:

1. location on a navigable waterway that connects directly with the intracoastal waterway,
2. availability of good water for process and cooling,
3. availability of rail facilities to the site, and
4. availability of economical fuel and electricity.

A rubber plant that is located in a market area rather than near the source of materials requires economical facilities for bringing in the raw materials. Alternate methods should also exist in case conditions change in the future. Since the lowest cost raw materials are available from plants on the Gulf Coast, the rubber plant preferably should be located on a navigable waterway that connects directly with the Gulf intracoastal waterway. The Chattahoochee River, with Columbus at the head of navigation, and the Flint River, with Bainbridge at the head of navigation, fit this requirement. Georgia also has three Atlantic coast ports that are connected to the deep-water Gulf Coast ports such as Beaumont, which is a propylene source. The Georgia Atlantic coast ports are Savannah, Brunswick and St. Marys. Even if the raw materials are shipped in by rail, location on a waterway will mean lower freight rates.

The Chattahoochee and Flint rivers have adequate supplies of usable water for process requirements. The Chattahoochee at Columbus, for example, has an average flow of 74,810 gallons per second and a hardness of 14.4 parts per million.

Industries along Georgia's Atlantic coast obtain their water supplies from wells as the entire area is underlaid by an aquifer. Large wells yield up to 4,000 gallons per minute and many artesian wells are in use in the area.

Several power companies serve Georgia. The Georgia Power Company's service area covers approximately 90% of the state. The rates are uniform throughout the company system. The power costs listed in Table 4 are given as an illustration, using the November 1962, fuel adjustment.

Table 4

ILLUSTRATIVE POWER COSTS - GEORGIA POWER COMPANY

| Monthly Consumption (Kilowatts) | 75% Load Factor | | 90% Load Factor | | Power Factor |
|---|---|---|---|---|---|
| | Rate (¢/KwHr.) | Monthly Bill 1/ | Rate (¢/KwHr.) | Monthly Bill 1/ | (%) |
| 15,000 | 1.625 | $251 | 1.544 | $239 | 85 |
| 30,000 | 1.564 | 483 | 1.503 | 465 | 85 |
| 80,000 | 1.224 | 1,009 | 1.191 | 982 | 85 |
| 150,000 | 1.094 | 1,690 | 1.061 | 1,638 | 85 |
| 500,000 | 0.886 | 4,563 | 0.854 | 4,398 | 85 |
| 1,000,000 | 0.83 | 8,549 | 0.797 | 8,209 | 85 |
| 6,570,000 | | | 0.74 | 50,058 | 90 |

1/ Includes 3% state sales tax.

Savannah Electric and Power Company serves Savannah and adjacent areas. The Crisp County Power Commission supplies Crisp County, and TVA serves a small area in the mountains of the extreme northern part of the state.

The development of the site area should complement the future possibilities of the synthetic rubber plant. Other plants can be located in the area that would utilize by-products and provide raw materials. Examples of products which are tailored to the needs of the Southeast and could be processed in a small regional complex include ammonia, caprolactam, acrylonitrile, polypropylene, chlorine and caustic soda.

## COMPARATIVE MANUFACTURING COSTS BETWEEN A GEORGIA LOCATION AND A TEXAS LOCATION

### Basis for the Comparison

A synthetic rubber plant in Georgia could serve a large market area at less delivered cost than a plant in Texas, as indicated in the cost comparisons in this section. The area that can be served economically from Georgia runs from Akron, Ohio, to the tip of Florida and from Birmingham, Alabama, to Baltimore, Maryland. (See Map 6.)

The Goodyear-Scientific Design process for producing isoprene and polyisoprene rubber was selected for the study because of the large amount of information available. The information not available was estimated from comparisons with similar technology.

In order to be specific, Columbus was chosen as the Georgia plant location because it meets the site requirements outlined on page 12. Goodyear has a plant in Beaumont, Texas, so the manufacturing costs are compared between these two points. Goodyear's Gadsden, Alabama, plant was chosen as the destination of the product in order to compare delivered costs. Map 6 shows the area of the United States where the total cost, including delivery, of synthetic rubber is less from Columbus than from Beaumont.

The accuracy of the cost estimate is expected to be within a 10% error, although the cost difference between the two locations may be off more than 10%. The comparison of costs of manufacture at different locations is not as dependent upon accurate process facts as it is upon accurate information on transportation costs, utility costs, labor rates, taxes and insurance.

### Cost Estimate Considerations

A comparative cost sheet for an isoprene plant in Columbus, Georgia, and Beaumont, Texas, is presented in Table 5. Information on the process is shown in Appendix 2. The following considerations were used in making the cost estimate:

MAP 6

AREA THAT CAN BE SERVED AT A LOWER COST FROM
A PLANT IN COLUMBUS, GEORGIA, THAN FROM A PLANT IN BEAUMONT, TEXAS

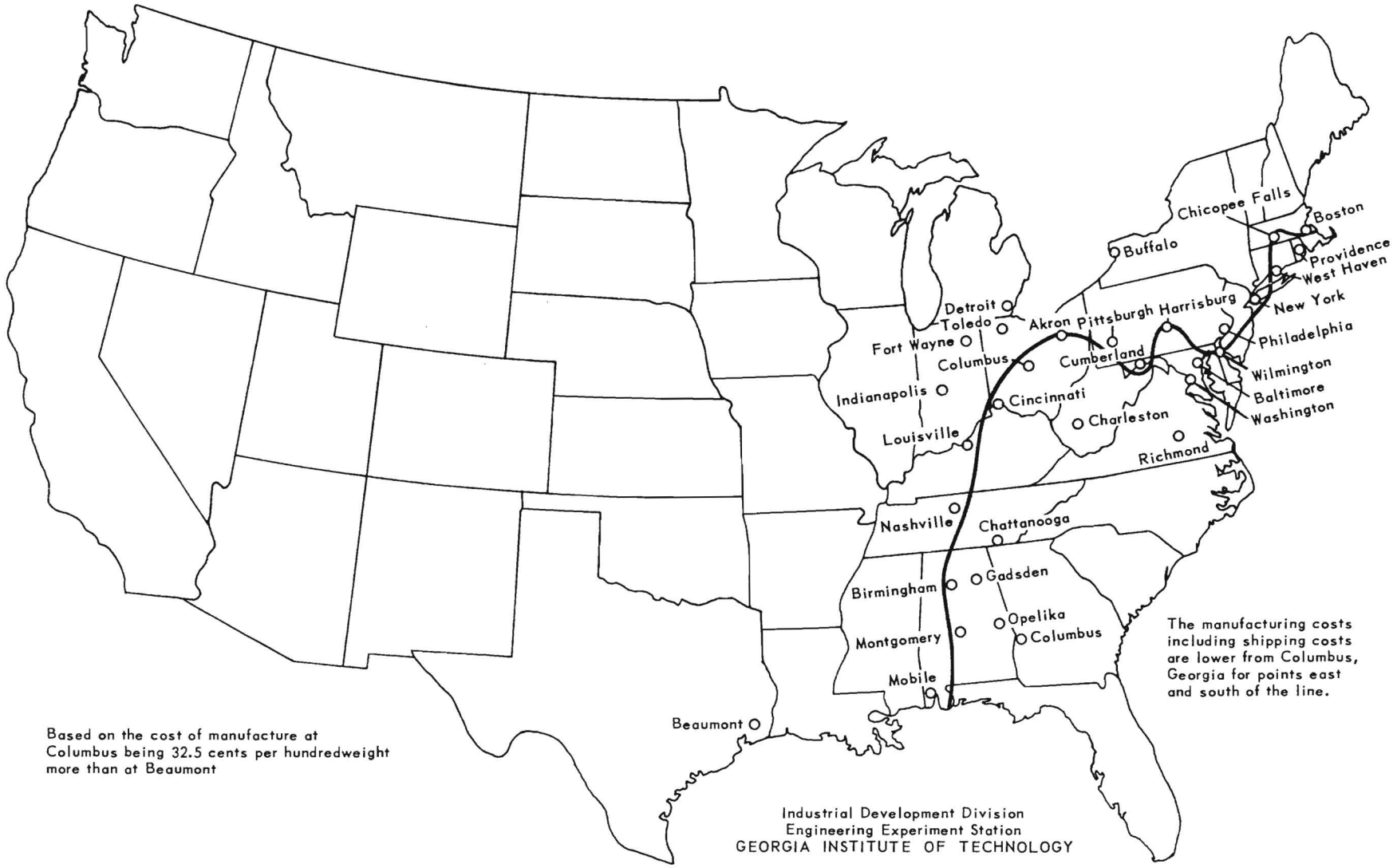


Table 5

ISOPRENE PLANT MANUFACTURING COST SHEET

Location: Columbus, Georgia, and Beaumont, Texas

Production: 45,000,000 lbs./yr. Capital: $8,640,000

| | Columbus | | Beaumont |
|---|---|---|---|
| | Dollar Amount | Unit Cost | Unit Cost |
| Raw Materials | | | |
| Propylene feedstock (99.0%) | $2,661,600 | $ .05923 | $ .0531 |
| Total Raw Materials | $2,661,600 | $ .05923 | $ .0531 |
| Process Supplies | | | |
| Tripropyl Aluminum Catalyst | | $ .0005 | $ .0005 |
| Acid type Catalyst | | .0010 | .0010 |
| Hydrogen Bromide Catalyst | | .0005 | .0005 |
| Total Process Supplies | | $ .002 | $ .002 |
| Utilities | | | |
| Electricity | | | |
| Process cooling water | | | |
| Steam (Included in Raw) | | | |
| Fuel Gas (Material ) | | | |
| Potable Water | | | |
| Total Utilities | | $ .003 | $ .003 |
| Plant Controlled Costs | | | |
| Operating Labor | $99,260 | $ .00221 | $ .00323 |
| Maintenance Material | 86,400 | .00192 | .00192 |
| Maintenance Labor | 86,400 | .00192 | .00276 |
| Supplies | 9,900 | .00022 | .00022 |
| Total Plant Controlled Cost | $281,960 | $ .00627 | .00813 |
| Assessments | | | |
| Laboratory | $4,500 | $ .00010 | $ .00012 |
| Factory Expense | 30,000 | .00067 | .0008 |
| Insurance | 86,400 | .00192 | .00192 |
| Taxes | 85,590 | .00186 | .00282 |
| Depreciation | 864,000 | .0192 | .0192 |
| Total Assessments | $1,070,490 | $ .02375 | $ .02486 |
| Total Cost, Bulk Monomer | | $ .09425 | $ .09109 |
| Polymerization | | $ .0790 | $ .0790 |
| Bulk Polyisoprene | | $ .17325 | $ .17000 |
| Shipping Cost to Gadsden, Alabama | | $ .0035 | $ .0071 |
| Total Cost Delivered per Pound | | $ .17675 | $ .17719 |

Raw Materials. The raw material is 99% propylene from Mobile Oil Company's new plant at Beaumont, Texas. This material is similar to LPG in that it can be shipped as a liquid under pressure. The cost of the feedstock at Beaumont is approximately 3.5¢ per pound. Actual price is negotiated.

Barge transportation of the propylene feedstock was used in the cost estimate. The subject plant would require 68,175,000 pounds per year and the shipping cost would be 0.405¢ per pound (1.7¢ per gallon). Propylene delivered in Columbus is 3.905¢ per pound. Using a 430,000 gallon barge, a load would be consumed every 8.75 days. Therefore, two barges would supply the plant. This illustration has been for a single barge tow to furnish the plant.

Alternate shipment methods are possible by pipe line or by tank car. The by-products from the plant will furnish all of the fuel gas needed to generate steam and for the cracking furnace. It is estimated that approximately 75% of the available by-product energy would be required. Excess by-products could be sold as natural gas and LPG; however, credit for these were not allowed in the cost estimate. The value of these items is much greater in Georgia than in Texas.

Process Supplies. Catalysts are the only known items in this category. Since all three catalysts are recovered in the process, only small amounts were provided for makeup.

Utilities. The major utility items, steam and fuel gas, are included in the raw materials. Values are obtained from similar technology to arrive at the three mills per pound of product cost for electricity, process cooling water and potable water.

Plant Controlled Costs. Staffing requirements were based on the following number of workers and current wage rates in the two areas:

| Personnel | Per Shift | Total | Rate for Columbus | Rate for Beaumont |
|---|---|---|---|---|
| Operators | 3 | 12 | $2.15 hr. | $3.40 hr. |
| Laboratory Technician | | 1 | $2.45 hr. | $3.25 hr. |
| Plant Foreman | | 1 | $3.25 hr. | $3.75 hr. |
| Plant Superintendent | | 1 | $9,000 yr. | $10,000 yr. |
| Clerk | | 1 | $1.73 hr. | $2.40 hr. |
| | | 16 | | |

For vacation, insurance, retirement, and other fringe benefits, 27% of payroll is allowed at both locations, although it is probable that the Beaumont costs would be higher.

The same number of workers are used for both plants. Since Beaumont is a strong union area, however, it is likely that more personnel will be required for the same plant. Maintenance labor is taken as 1% for the Columbus plant, but a proportionately higher figure is used for the Beaumont plant. An average ratio of $2.40 per hour is used for Columbus and $3.45 per hour is used for Beaumont, where rates are 44% higher.

Assessments. The amount used in the estimate for laboratory and factory expense is derived from experience with operations of similar size. Half of the cost is calculated as wages and salaries and the Beaumont rate is 40% higher. The estimate used for insurance is 1% of the direct capital.

Taxes are calculated from rates and assessments listed in Moody's Municipals and Governments.

The amount used for depreciation is 10%. Depreciation is a major item in the total bulk cost, second only to raw material cost. This can be lowered by reducing the capital requirements through process and equipment modifications. From the limited information available on this process, $8,640,000 has been allowed for direct capital for the isoprene plant. The Beaumont plant is reported to be a $20 million investment for the production of 20,000 long tons of Cis-polyisoprene and 10,000 long tons of Cis-polybutadiene in separate polymerization plants. The butadiene will be purchased.

Polymerization Cost. Polymerization cost is reported from plants operating for 10 years and more. The cost of 7.9¢ per pound is used as reported.[1/]

Shipping Cost. The cost of rail transportation for the finished bales of synthetic rubber was computed from the following rates:

Beaumont, Texas to Gadsden, Alabama -- 71¢ per 100 lbs. on 80,000 lb. car.

Columbus, Georgia to Gadsden, Alabama -- 35¢ per 100 lbs. on 80,000 lb. car.

---

1/ Chemical Week, May 6, 1961, page 78.

This commodity rate from Beaumont is currently in effect, and a rate specialist has estimated the rate that could be established from Columbus.

Total Cost Delivered. The delivered cost in Gadsden would be 17.68¢ per pound manufactured in Columbus, as compared with 17.72¢ per pound in Beaumont.

Conclusion

On the comparative cost sheet (where only Gadsden, which is west of Columbus, is being served), the advantages of the Georgia location outweigh the disadvantage of shipping in the raw material. The advantages on an annual basis for 45 million pounds production are:

| | |
|---|---|
| Product Shipping Cost Advantage | $162,000 |
| Labor Cost Advantage | 90,450 |
| Tax Advantage | 43,200 |
| Total Advantages | $295,650 |

The disadvantage of shipping the raw material amounts to $275,850. The resulting Columbus advantage, therefore, is $19,800 per year.

Even based on the premise that all the rubber manufactured at Columbus were shipped to the west where the freight advantage is least (i.e., Gadsden, Alabama), a Columbus plant would still have an advantage over a Beaumont plant. This dollar advantage would grow rapidly with the proportion of product that is shipped to the east or north of Columbus. (See Map 6.)

The increasing markets in the Southeast and the efforts of Georgia communities to become more attractive to industry point to a continuing increase in the advantages in the years ahead.

# APPENDICES

Appendix 1

RUBBER GOODS MANUFACTURERS IN THE STUDY AREA
(See Map 2.)

ALABAMA

1. Albertville
   American Rubber Corporation - Floor tile

2. Birmingham
   Neely Roller Company - Rubber covered rollers
   Paranite Wire & Cable Division, Essex Wire Corporation - Rubber and plastic covered wire
   Relief Manufacturing Company - Tire and tube repair kits
   Southern Products Corporation - Molded rubber goods, gaskets, packings
   United Engineers, Inc. - Laboratory supplies, mechanical goods
   Vulcan Printing Plate Company - Rubber plates, printing mats

3. Demopolis
   Borden Chemical Company -

4. Florence, Listerhill, Sheffield, Tuscumbia
   Muscle Shoals Rubber Company, Sheffield - Rubber heels, soles, balls, etc.
   National Floor Products Company, Inc., Florence - Floor tile
   Reynolds Metals Company, Listerhill - Insulated wire and cable
   Robbins Floor Products, Inc., Tuscumbia - Rubber and vinyl floor tile
   Robbins Tire & Rubber Company, Tuscumbia - Tires, tubes, rubber products
   White Rubber Products, Florence - Solid rubber tires, wheels

5. Gadsden
   Goodyear Tire & Rubber Company - Tires and tubes

6. Guntersville
   Gates Rubber Company - Tread rubber

7. Mobile
   Southern Tire & Patch Company - Rubber products
   Vacuum Grip Cover Company - Rubber products

8. Montgomery
   Willbanks Rubber Manufacturing Company - Tread rubber

9. Opelika
   U. S. Rubber Company - Tires (Completion: Early 1964)

10. Talladega
    Syna-Flex Rubber Products Company - Mechanical rubber goods, tank linings

11. Tuscaloosa
    B. F. Goodrich Company - Tires, tubes, tank and pipe linings

FLORIDA

1. Fort Myers
   Elastomers, Inc. - Dipped and molded specialties

2. Hialeah
   East Coast Rubber & Plastic Company, Inc. - Industrial rubber products
   Florida Foam Products, Inc. - Polyurethane
   Gulfstream Plastics, Inc. - Molded vinyl goods

3. Jacksonville
   Hect Rubber Company, Inc. - Mats, aprons, pads
   Herco Rubber Crafters - Rubber goods
   Jax Rubber Products Company - Mats

4. Lake Alfred
   Lorraine Manufacturing Division of National Industries - Molded products

5. Miami
   Akron Foam Rubber Products Company - Foam rubber fabrication
   Irvington Division of Minnesota Mining & Manufacturing Company - Molded and extruded goods
   Miami Lighthouse for the Blind - Mats
   Rubber, Inc. - Mounts, pads and mats
   Southern Rubber Company - Matting, hose

6. St. Petersburg
   Goodyear Rubber Products Company - Mats
   Royal Mat Manufacturers - Mats

7. Tampa
   General Cable Corporation - Insulated wire and cable
   Hofran, Inc. - Mats
   Rubber Products, Inc. - Tile

8. West Palm Beach
   Lions Industries for the Blind - Mats

GEORGIA

1. Athens
   Southeastern Rubber Manufacturing Company, Inc. - Tread rubber and tire repair material

2. Atlanta
   All-Metal Cooler Corporation - Bolo paddle balls
   American Seal and Stamp Company - Rubber stamps
   The Arabol Manufacturing Company - Industrial adhesives
   Bingham's, Samuel, Son Manufacturing Company - Industrial rubber and printer rollers
   Central Cable Corporation, Tucker - Electric wire and cable
   Flexible Metal Hose & Rubber Products Company - Rubber assemblies and metal hose

2. Atlanta (Cont'd)
   H. B. Fuller Company of Georgia - Adhesives
   Howard Products Company - Laminating foam rubber
   Ideal Roller and Manufacturing Company, Chamblee - Printing rollers
   Latex Foam Rubber Corporation - Foam synthetic rubber
   Morningstar-Paisley, Inc. - Latex adhesives and compounds, solvent and vinyl cements
   Precision Rubber Plate Company - Rubber printing plates
   Surface Coatings, Inc. - Latex concrete additives

3. Austell
   Southern Latex Corporation - Latex adhesive compounds

4. Bowden
   Textile Rubber Company, Inc. - Rubber and plastic molded items

5. Carrollton
   Southwire Company - Wire and cable products
   Testworth Laboratories of Georgia, Inc. - Latex compounds, adhesives

6. Conyers
   U. S. Rubber Company - Retread rubber (start up - not announced)

7. Covington
   Brunswick Corporation - Sporting goods (including golf balls)

8. Dahlonega
   Pine Tree Company, Unit of James Lees & Sons Company - Carpets

9. Dalton
   Cabin Crafts, Inc. - Non-skid rug backings
   Curon of Georgia, Division of Reeves Bros., Inc. - Latex backing
   Dee's Adhesives and Chemicals - Latex backing
   G & C Rubber Coating Company - Latex backing
   General Latex and Chemical Corporation - Latex
   Textile Rubber and Chemical Company - Latex

10. Dawson
    Yale Rubber Company - Mechanical goods

11. Flowery Branch
    Georgia Shoe Manufacturing Company, Inc. - Boots and shoes

12. Griffin
    Stowe-Woodward, Inc. - Rubber covered rolls

13. Jasper
    Jasper Rubber Company, Subsidiary of Stalwart Rubber Company - rubber products

14. Macon
Cherokee Rubber Company, Inc. - Foam rubber bust forms
General Tire and Rubber Company - Retread rubber
Hall, Virginia, Inc. - Foam rubber bust pads and footwear
Trion Rubber Company - Foam rubber products

15. Manchester
International Latex Corporation - Shower caps, brassieres

16. Marietta
Arabol Manufacturing Company - Latex adhesives and cements

17. Rabun Gap
James Lee & Sons Company - Tufted carpets

18. Rockmart
Goodyear Tire & Rubber Company - Life rafts, radomes

19. Swainsboro
New York Rubber Corporation - Inflatable rubber products

20. Tallapoosa
American Hard Rubber Company - Rubber compound
Associated Rubber Company - Tread rubber

21. Thomaston
B. F. Goodrich Company - Tire fabrics

22. Watkinsville
Anaconda Wire and Cable Company - Electric wire and cable

23. Waycross
Ace Rubber Products, Inc. - Mats and matting - (Start up - December 1962)

NORTH CAROLINA

1. Albemarle
Collins & Aikman Corporation - Latex coated fabrics, wool weaving and finishing

2. Butner
Athol Manufacturing Company - Coated fabrics

3. Ca-Vel
Collins & Aikman Corporation -

4. Charlotte
General Latex and Chemical Corporation - Latexes
Radiator Specialty Company - Mechanical and molded rubber goods
Scandura, Inc. - Belting
Wica Chemicals, Inc. - Latex

5. Concord
   Southern Latex Corporation - Latex

6. Fayetteville
   Borden Chemical Company - Adhesives and Chemical Division -

7. Fuquay Springs
   Dixie Rubber Company -

8. Gastonia
   Naugatuck Chemical Division, U. S. Rubber Company - Synthetic elastic thread

9. Greensboro
   Olympic Chemical Company - Polyurethane foam

10. Hickory
    Elastic Corporation - Covered rubber thread
    Shuford Mills, Inc. - Pressure sensitive tape

11. High Point
    Fli-Back Company - Cellular goods, latex dipped goods

12. Lenoir
    Lenoir Wood Finishing Company - Latex rug backing, vinyl and urethane foam

13. Marshville
    Union Asbestos & Rubber Company - Mechanical rubber goods

14. Mount Airy
    Carolina Industrial Plastics Division, Essex Wire Corporation - Flexible-rigid vinyl extrusions, vinyl foam

15. Mount Gilead
    Gro-Rite Shoe Company - Molded soling slabs

16. Robbinsville
    James Lees & Sons Company - Latex rug backing

17. Rutherfordton
    Vulcan Rubber Products Division, Reeves Bros., Inc. - Rubber sheeting and coated fabrics

18. Salisbury
    Carolina Rubber Hose Company - Hard rubber tank linings, mechanical goods

19. Sanford
    Roberts Company - Textile specialties

20. Shelby
    Seal Wire Company - Polyethylene insulated wire and cable

21. Statesville
    William T. Burnett & Company - Polyurethane foam products

22. Waxhaw
    Filatex Corporation - Covered rubber and latex thread

23. Waynesville
    Dayco Corporation -
    Wellco Shoe Corporation - Footwear

24. Wilmington
    Timme Corporation - Latex coated fabrics

SOUTH CAROLINA

1. Cayce
    Continental Chemical Company - Tapes, proofed goods, soles, coated fabrics

2. Charleston
    Charleston Rubber Company - Gloves, aprons, sleeves

3. Greenville
    Polymer Industries, Inc. - Latex compounds
    Para-Chem Southern, Inc. - Latex compounds

4. LaFrance
    LaFrance Industries - Coated fabrics

5. North Charleston
    General Asbestos & Rubber Division
    Raybestos-Manhattan, Inc. - Mechanical goods and proofed goods
    Manhattan Rubber Division, Raybestos-Manhattan, Inc. - Mechanical goods, sporting goods

6. Spartanburg
    Poly Products Company - Balloons, balls
    Rubber & Tire Materials Company - Tread rubber and tire repair materials

7. Westminster
    Dunlop Tire & Rubber Corporation - Golf balls

TENNESSEE

1. Baxter
    Georgia Shoe Manufacturing Company - Boots and work shoes

2. Chattanooga
    Burkart-Schier Chemical Company - Latex compounds
    Consolidated Latex Company, Inc. - Latex compounds
    J. G. Milligan & Company - Latex compounds
    Mitchel Industrial Tire Company - Laminated industrial tires

2. Chattanooga (Cont'd)
   Nopco Chemical Company - Urethane foam products
   Notat Tire Company - Laminated industrial tires
   The Rubber Products Company, Inc. - Foam rubber and urethane foam
   Southern Electrical Company - Electrical transmission cable

3. Clarksville
   B. F. Goodrich Company - Shoe products

4. Crossville
   Crossville Rubber Products, Inc. - Rubber mats

5. Dyersburg
   Colonial Rubber Works, Inc. - Blown sponge
   The Max Pillow Company - Rubber boat anchors

6. Etowah
   Blocksom & Company - Rubberized curled hair for upholstering

7. Greenback
   Miltron Corporation - Latex compounds, underlay

8. Lebanon
   Lebanon Manufacturing Company - O-rings

9. Lewisburg
   Venus Pen and Pencil Corporation - Erasers

10. Memphis
    Firestone Tire & Rubber Company - Tires and tubes
    H. B. Fuller Company - Industrial adhesives
    General Cable Corporation - Electric wire and cable
    Hanley Corporation - Foam rubber cushioning
    Rite-Way Products Company - Tire and tube repair materials

11. Milan
    U. S. Rubber Company - Camel back

12. Morristown
    Henrite Products Corporation - Mountings, bonded specialties

13. Nashville
    Gates Rubber Company, Inc. - Tires
    General Adhesives Company, Division of GENESCO, Inc. - Shoe and industrial adhesives
    Genfoam Shoe Company, Division of GENESCO, Inc. - Vulcanized footwear
    Genruco Processing Company - Rubber compounds
    Tennessee Mat Company - Rubber door mats and rubber matting
    Tennessee Wheel & Rubber Company - Industrial rubber tired wheels

14. Paris
    The Bowling Green Rubber Company - Extruded rubber

15. Pulaski
Pulaski Rubber Company - Semi-pneumatic, solid and industrial tires

16. Shelbyville
Allied Rubber Division, Southern Graphite Company - Erasers and pencil leads

17. Springfield
Mansfield Tire & Rubber Company - Molded cellulose base products

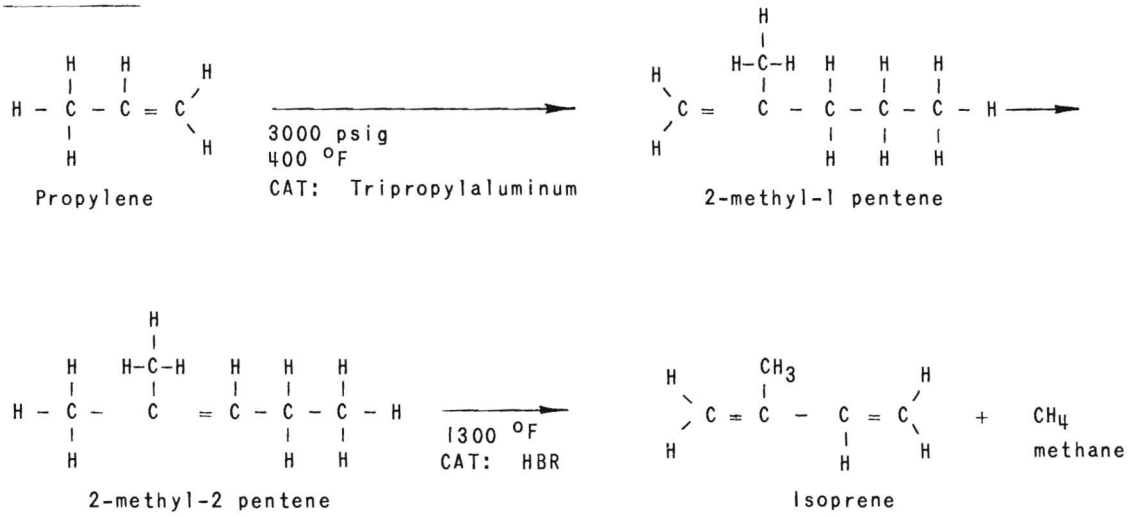
---

SOURCES: Official State Manufacturing Directories
1962 Rubber Red Book
Industrial Development Division Files

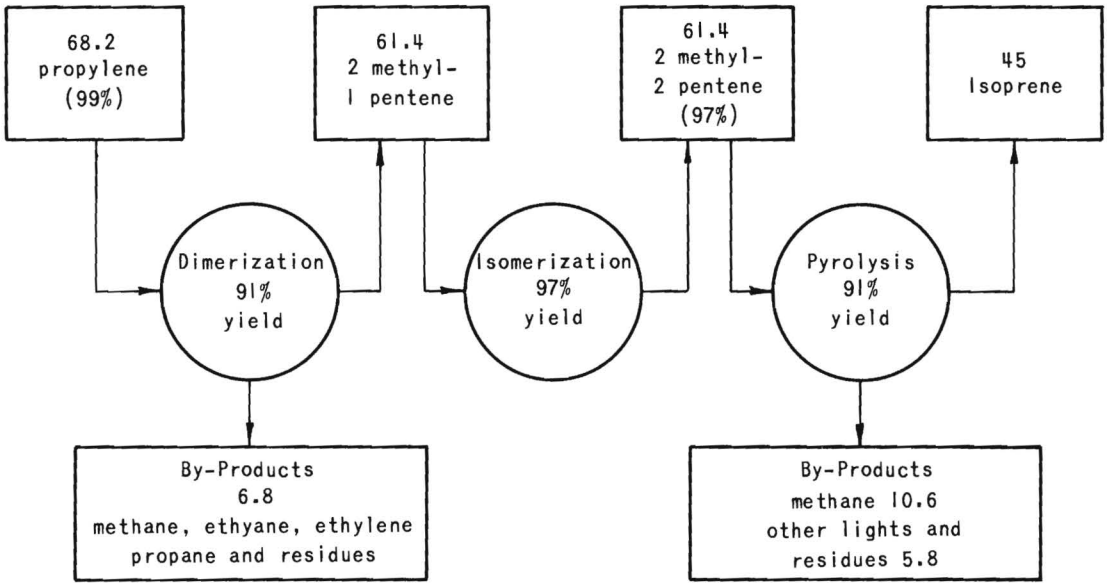
Appendix 2

PROCESS INFORMATION FOR THE PRODUCTION OF ISOPRENE
FROM PROPYLENE

CHEMISTRY




MATERIAL BALANCE (millions of pounds per year)




Heat Balance (annual basis)

| | |
|---|---|
| Combustible by-products | 23,200,000 pounds |
| Heat available from by-products | 471 billion BTU |
| Cracking furnace requirement | 218 billion BTU |
| Distillation requirement | 88 billion BTU |
| Total | 306 billion BTU |
| Surplus methane available for sale | 7,670,000 pounds |
| Resale value in Southeast @ 22.6¢/mcf | $40,800 |

FLOW SHEET FOR MAKING ISOPRENE BY THE
GOODYEAR SCIENTIFIC DESIGN PROCESS